

CLAIMS

1. An electrolytic processing apparatus comprising:
a processing electrode for processing a workpiece;
5 a feeding electrode for feeding electricity to the workpiece;
a power source for applying a voltage between the processing electrode and the feeding electrode;
a pressure tight container housing the processing electrode
10 and the feeding electrode therein; and
a high-pressure liquid supply system for supplying a high-pressure liquid into the pressure tight container.
2. The electrolytic processing apparatus according to
15 claim 1, wherein a contact member is provided between the workpiece and at least one of the processing electrode and the feeding electrode.
3. The electrolytic processing apparatus according to
20 claim 2, wherein the contact member comprises an ion exchanger or a polishing pad.
4. The electrolytic processing apparatus according to
claim 2, wherein the pressure of the high-pressure liquid to
25 be supplied into the pressure tight container is not lower than 2 kgf/cm².
5. The electrolytic processing apparatus according to claim
2, wherein the high-pressure liquid supply system is provided
30 with a heat exchanger for adjusting a temperature of the high-pressure liquid to be supplied into the pressure tight container.

6. The electrolytic processing apparatus according to claim 1, further comprising:

an electrode section including the feeding electrode and the processing electrode; and

5 a contact member disposed between the electrode section and the workpiece and/or between the processing electrode and the feeding electrode of the electrode section.

7. The electrolytic processing apparatus according to
10 claim 6, wherein the contact member comprises an ion exchanger or a polishing pad.

8. The electrolytic processing apparatus according to
15 claim 6, wherein the pressure of the high-pressure liquid to be supplied into the pressure tight container is not lower than 2 kgf/cm².

9. The electrolytic processing apparatus according to claim
20 6, wherein the high-pressure liquid supply system is provided with a heat exchanger for adjusting a temperature of the high-pressure liquid to be supplied into the pressure tight container.

10. The electrolytic processing apparatus according to
25 claim 1, wherein the high-pressure liquid supply system is provided with a heat exchanger for adjusting a temperature of the high-pressure liquid to be supplied into the pressure tight container.

30 11. The electrolytic processing apparatus according to claim 1, wherein the high-pressure liquid supply system is provided with a degassing device for releasing dissolved gas from the high-pressure liquid to be supplied into the pressure tight container.

12. An electrolytic processing apparatus comprising:
a processing electrode for processing a workpiece;
a feeding electrode for feeding electricity to the workpiece;
- 5 a power source for applying a voltage between the processing electrode and the feeding electrode; and
a liquid supply system for supplying a liquid between the workpiece and at least one of the processing electrode and the feeding electrode;
- 10 wherein the liquid supply system is provided with a heat exchanger for adjusting a temperature of the liquid to be supplied between the workpiece and at least one of the processing electrode and the feeding electrode.
- 15 13. The electrolytic processing apparatus according to claim 12, wherein a contact member is provided between the processing electrode and the workpiece.
- 20 14. The electrolytic processing apparatus according to claim 13, wherein the contact member comprises an ion exchanger or a polishing pad.
- 25 15. The electrolytic processing apparatus according to claim 13, wherein the heat exchanger adjusts the liquid to be supplied between the workpiece and the contact member so that a liquid temperature becomes not more than 25°C.
- 30 16. The electrolytic processing apparatus according to claim 12, further comprising:
an electrode section including the feeding electrode and the processing; and
a contact member disposed between the electrode section and the workpiece and/or between the processing electrode and the feeding electrode of the electrode section.

17. The electrolytic processing apparatus according to claim 16, wherein the contact member comprises an ion exchanger or a polishing pad.

5 18. The electrolytic processing apparatus according to claim 16, wherein the heat exchanger adjusts the liquid to be supplied between the workpiece and the contact member so that a liquid temperature becomes not more than 25°C.

10 19. An electrolytic processing apparatus comprising:
an electrode section including an electrode member comprised of an electrode and an ion exchanger covering a surface of the electrode;

15 a holder for holding a workpiece and bringing the workpiece into contact with the ion exchanger of the electrode member;

a liquid supply system for supplying a liquid between the ion exchanger and the workpiece held by the holder;

a drive mechanism for causing relative movement between the electrode section and the workpiece; and

20 a power source to be connected to the electrode of the electrode member of the electrode section;

wherein a continuous contact time of the ion exchanger with a point in a processing surface of the workpiece is not more than 10 msec.

25 20. The electrolytic processing apparatus according to claim 19, wherein the drive mechanism is designed to cause relative movement between the electrode section and the workpiece at a relative speed of not lower than 0.2 m/sec.

30 21. The electrolytic processing apparatus according to claim 19, wherein the ion exchanger covering the electrode is designed to make contact with the workpiece held by the holder with a contact width of 0.2 to 1.5 mm.

22. The electrolytic processing apparatus according to claim 21, wherein the drive mechanism is designed to cause relative movement between the electrode section and the workpiece at a relative speed of not lower than 0.2 m/sec.

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23. An electrolytic processing apparatus comprising:
an electrode section including an electrode member comprised of an electrode and an ion exchanger covering a surface of the electrode;

10 a holder for holding a workpiece and bringing the workpiece into contact with the ion exchanger of the electrode member;

a liquid supply system for supplying a liquid between the ion exchanger and the workpiece held by the holder;

15 a drive mechanism for causing relative movement between the electrode section and the workpiece; and

a power source to be connected to the electrode of the electrode member of the electrode section;

20 wherein an on/off or positive/negative control of the power source is performed in synchronization with the relative movement between the electrode section and the workpiece.

24. The electrolytic processing apparatus according to claim 23, wherein the on/off control is performed such that the power source is on when the relative speed between the electrode
25 of the electrode section and the workpiece in the width direction of the electrode section is not lower than 0.2 m/sec.

25. An electrolytic processing method comprising:
processing a workpiece in the presence of a high-pressure
30 liquid by applying a voltage to an electrode section.

26. The electrolytic processing method according to claim 25, wherein the high-pressure liquid is supplied between the electrode section and the workpiece.

27. The electrolytic processing method according to claim 25, wherein the workpiece is processed by immersing the workpiece and the electrode section in the high-pressure liquid.

5 28. The electrolytic processing method according to claim 25, wherein the electrode section includes a processing electrode for processing the workpiece and a feeding electrode for feeding electricity to the workpiece.

10 29. The electrolytic processing method according to claim 25, wherein a pressure of the high-pressure liquid is not lower than 2 kgf/cm².

15 30. The electrolytic processing method according to claim 28, wherein a contact member is provided between the workpiece and at least one of the processing electrode and the feeding electrode.

20 31. The electrolytic processing method according to claim 30, wherein the contact member comprises an ion exchanger or a polishing pad.

25 32. An electrolytic processing method comprising:
processing a workpiece in the presence of a high-pressure liquid by applying a voltage to an electrode section;
wherein the electrode section includes a processing electrode for processing the workpiece and a feeding electrode for feeding electricity to the workpiece.

30 33. The electrolytic processing method according to claim 32, wherein a contact member is provided between the workpiece and at least one of the processing electrode and the feeding electrode.

34. The electrolytic processing method according to claim 33, wherein the contact member comprises an ion exchanger or a polishing pad.

5 35. An electrolytic processing method comprising:
 providing a processing electrode which can come close to
 or into contact with a workpiece, and a feeding electrode for
 feeding electricity to the workpiece; and
 processing the workpiece by applying a voltage between the
10 processing electrode and the feeding electrode while supplying
 a liquid at an adjusted temperature between the workpiece and
 at least one of the processing electrode and the feeding electrode.

 36. The electrolytic processing method according to claim
15 35, wherein an ion exchanger is provided between the workpiece
 and at least one of the processing electrode and the feeding
 electrode.

 37. An electrolytic processing method comprising:
20 providing a processing electrode which can come close to
 or into contact with a workpiece, and a feeding electrode for
 feeding electricity to the workpiece; and
 processing the workpiece by applying a voltage between the
 processing electrode and the feeding electrode while supplying
25 a degassed liquid between the workpiece and at least one of the
 processing electrode and the feeding electrode.

 38. The electrolytic processing method according to claim
30 37, wherein an ion exchanger is provided between the workpiece
 and at least one of the processing electrode and the feeding
 electrode.

39. An electrolytic processing method comprising:

processing a workpiece in the presence of a liquid by applying a voltage to an electrode and moving an ion exchanger, covering a surface of the electrode, and the workpiece held by
5 a holder relative to each other, while keeping the ion exchanger and the workpiece in contact with each other, such that the contact time of the ion exchanger with a point in a processing surface of the workpiece is not more than 10 msec.

10 40. The electrolytic processing method according to claim 39, wherein the ion exchanger and the workpiece held by the holder contact each other with a contact width of 0.2 to 1.5 mm.

15 41. The electrolytic processing method according to claim 39, wherein the ion exchanger and the workpiece held by the holder are moved relative to each other at a relative speed of not less than 0.2 m/sec while keeping them in linear contact with each other.

20 42. The electrolytic processing method according to claim 40, wherein the ion exchanger and the workpiece held by the holder are moved relative to each other at a relative speed of not less than 0.2 m/sec while keeping them in linear contact with each other.

25 43. An electrolytic processing method comprising:
processing a workpiece in the presence of a liquid by applying a voltage to a plurality of electrodes arranged in parallel and moving an ion exchanger, covering the surfaces of
30 the plurality of electrodes, and the workpiece held by a holder relative to each other while keeping the ion exchanger and the workpiece in contact with each other;

wherein the voltage is on/off or positive/negative controlled in synchronization with the relative movement.

44. The electrolytic processing method according to claim 43, wherein the liquid is pure water, ultrapure water, or a liquid having an electric conductivity of not more than 500 $\mu\text{S}/\text{cm}$.

5 45. An electrolytic processing method comprising:
bringing a workpiece and a processing electrode close to
or into contact with each other; and
processing the workpiece in the presence of a liquid by
applying a voltage between the workpiece and the processing
10 electrode while moving the workpiece and the processing electrode
relative to each other;
wherein the relative speed between the workpiece and the
processing electrode is made fast in an initial processing stage
and slow in a later processing stage.

15 46. The electrolytic processing method according to claim
45, wherein the relative speed between the workpiece and the
processing electrode is made slow when a thickness of a film,
which is formed in a processing surface of the workpiece and
20 is being processed, has reached a value of not more than 600
nm.

47. The electrolytic processing method according to claim
45, wherein the relative speed between the workpiece and the
25 processing electrode is changed stepwise.

48. The electrolytic processing method according to claim
45, wherein the relative speed between the workpiece and the
processing electrode is changed continuously.

30 49. The electrolytic processing method according to claim
45, wherein a contact member is provided between the workpiece
and the processing electrode.

50. The electrolytic processing method according to claim 49, wherein the contact member comprises an ion exchanger or a polishing pad.

5 51. The electrolytic processing method according to claim 45, further comprising:

providing a feeding electrode for feeding electricity to the workpiece; and

10 disposing a contact member between the feeding electrode and the workpiece.

52. The electrolytic processing method according to claim 51, wherein the contact member comprises an ion exchanger or a polishing pad.

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53. An electrolytic processing method comprising:

bringing a workpiece and a processing electrode close to or into contact with each other; and

20 processing the workpiece in the presence of a liquid by applying a voltage between the workpiece and the processing electrode while moving the workpiece and the processing electrode relative to each other;

wherein the relative speed between the workpiece and the processing electrode is made fast in an initial processing stage, 25 slow in an intermediate processing stage, and faster in a later processing stage than the intermediate processing stage.

54. The electrolytic processing method according to claim 53, wherein the relative speed between the workpiece and the 30 processing electrode is made slow when a thickness of a film, which is formed in a processing surface of the workpiece and is being processed, has reached a value of not more than 600 nm, and the relative speed between the workpiece and the processing electrode is made again fast when a thickness of the film has 35 reached a value of 50 to 300 nm.

55. The electrolytic processing method according to claim 53, wherein the relative speed between the workpiece and the processing electrode is changed stepwise.

5 56. The electrolytic processing method according to claim 53, wherein the relative speed between the workpiece and the processing electrode is changed continuously.

57. The electrolytic processing method according to claim 10 53, further comprising:

disposing a contact member between the workpiece and the processing electrode.

58. The electrolytic processing method according to claim 15 57, wherein the contact member comprises an ion exchanger or a polishing pad.

59. The electrolytic processing method according to claim 53, further comprising:

20 providing a feeding electrode for feeding electricity to the workpiece; and

disposing a contact member between the feeding electrode and the workpiece.

25 60. The electrolytic processing method according to claim 59, wherein the contact member comprises an ion exchanger or a polishing pad.

61. An electrolytic processing method comprising:
30 bringing a workpiece and a processing electrode close to or into contact with each other; and

processing the workpiece in the presence of a liquid by applying a voltage between the workpiece and the processing electrode while moving the workpiece and the processing electrode
35 relative to each other;

wherein the relative speed between the workpiece and the processing electrode is made slow in an initial processing stage and fast in a later processing stage.

5 62. The electrolytic processing method according to claim 61, wherein the relative speed between the workpiece and the processing electrode is made fast when a thickness of a film, which is formed in a processing surface of the workpiece and is being processed, has reached a value of 50 to 300 nm.

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63. The electrolytic processing method according to claim 61, wherein the relative speed between the workpiece and the processing electrode is changed stepwise.

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64. The electrolytic processing method according to claim 61, wherein the relative speed between the workpiece and the processing electrode is changed continuously.

20 65. The electrolytic processing method according to claim 61, further comprising:

disposing a contact member between the workpiece and the processing electrode.

25 66. The electrolytic processing method according to claim 65, wherein the contact member comprises an ion exchanger or a polishing pad.

30 67. The electrolytic processing method according to claim 61, further comprising:

providing a feeding electrode for feeding electricity to the workpiece; and

disposing a contact member between the feeding electrode and the workpiece.

68. The electrolytic processing method according to claim 67, wherein the contact member comprises an ion exchanger or a polishing pad.

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69. An electrolytic processing method comprising:

bringing a workpiece and a processing electrode close to or into contact with each other; and

processing the workpiece in the presence of a liquid by
10 applying a voltage between the workpiece and the processing electrode while causing relative movement between the workpiece and the processing electrode by allowing the workpiece and/or the processing electrode to make a cyclic movement;

wherein the cycle of the cyclic movement of the workpiece
15 and/or the processing electrode is changed during processing.